T15D12 – Entropy IB Practice

Name……..

1. Which reaction causes a decrease in the entropy of the system?

A. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

B. $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

C. $2C(s) + O_2(g) \rightarrow 2CO(g)$

D. $2SO_3(g) \rightarrow 2SO_2(g) + O_2(g)$

2. Which equation represents a change with a negative value for ΔS?

A. $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

B. $H_2O(s) \rightarrow H_2O(g)$

C. $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$

D. $2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

3. Which reaction has the greatest positive entropy change?

A. $CH_4(g) + 1½O_2(g) \rightarrow CO(g) + 2H_2O(g)$

B. $CH_4(g) + 1½O_2(g) \rightarrow CO(g) + 2H_2O(l)$

C. $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

D. $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

4. Consider the following reaction:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

(i) Suggest why this reaction is important for humanity. (next unit)

(1)

(ii) Using the average bond enthalpy values in Table 10 of the Data Booklet, calculate the standard enthalpy change for this reaction.

(4)

(iii) The absolute entropy values, *S*, at 238 K for $N_2(g)$, $H_2(g)$ and $NH_3(g)$ are 192, 131 and 193 J K^{-1} mol^{-1} respectively. Calculate $\Delta S^{\ominus}$ for the reaction and explain the sign of $\Delta S^{\ominus}$.

(2)

(iv) Calculate $\Delta G^{\ominus}$ for the reaction at 238 K. State and explain whether the reaction is spontaneous.

(3)

(v) If ammonia was produced as a liquid and not as a gas, state and explain the effect this would have on the value of $\Delta H^{\ominus}$ for the reaction.

(2)

(Total 12 marks)

5. Hex-1-ene gas, C_6H_{12}, burns in oxygen to produce carbon dioxide and water vapor.

(a) Write an equation to represent this reaction.

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(1)

(b) Use the data below to calculate the values of $\Delta H_C^\ominus$ and $\Delta S_C^\ominus$ for the combustion of hex-1-ene.

Substance	$O_2(g)$	$C_6H_{12}(g)$	$CO_2(g)$	$H_2O(g)$
Standard enthalpy of formation, $\Delta H_f^\ominus$ / kJ^{-1} mol	0.0	–43	–394	–242
Entropy, $S^\ominus$ / J K^{-1} mol^{-1}	205	385	214	189

(i) Value of $\Delta H_C^\ominus$

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(2)

(ii) Value of $\Delta S_C^\ominus$

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(2)

(c) Calculate the standard free energy change for the combustion of hex-1-ene.

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(2)

(d) State and explain whether or not the combustion of hex-1-ene is spontaneous at 25□C.

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(1)

(Total 8 marks)

6. (a) Propyne reacts with hydrogen as follows:

$$C_3H_4(g) + 2H_2(g) \rightarrow C_3H_8(g) \qquad \Delta H^\ominus = -287 \text{ kJ}$$

Calculate the standard entropy change of this reaction, given the following additional information:

$S^\ominus$ of $H_2(g)$ = 131 J K^{-1} mol^{-1}

(3)

(b) Calculate the standard free energy change at 298 K, $\Delta G^\ominus$, for the reaction in part (a). Use your answer and relevant information from part (d). If you did not obtain an answer to part (a), use $\Delta S^\ominus$ = –360 J K^{-1} (this is not the correct value).

(3)

(Total 6 marks)